seasonal trends in larval abundance and seasonal changes in water temperature seemed to be related. In 1963, however, this relation was not as apparent; it seems that spawning, larval abundance, or both, may not be related to a specific temperature but perhaps to changes in temperature.

Noncommercial Species

Distinct patterns of depth distribution and trends of abundance were evident for the noncommercial planktonic-stage penaeids in our plankton hauls. Species of Sicyonia and "TX" occurred most frequently inside the 25-fath. contour, whereas species of Solenocera and Parapenaeus were most frequently found in deeper waters. In addition, species of Sicyonia "TX" and Solenocera occurred in greater numbers between August and October; species of Parapenaeus were most abundant in January and February.

Clarence C. Fischer, Project Leader

IDENTIFICATION AND CULTURE OF SHRIMP LARVAE

The primary aim of this project is to develop methods of rearing penaeid shrimp so that larvae of known parentage may be obtained for comparative morphological studies. During the past year three species have been reared to postlarvae: brown shrimp, pink shrimp, and Trachypeneus similis. A preliminary examination showed that brown and pink shrimp larvae had no significant differences in setation or other easily observed body parts. The ratios of various body parts might be significantly different, but the larvae were too few for a detailed study. Several series of larvae, obtained at different seasons from females of each species, are now being accumulated for examination.

A secondary goal is to determine methods of rearing penaeid larvae en masse to supply shrimp grown under known conditions for physiological and pond-culture studies. In early culture experiments, larvae in limited numbers could be reared to postlarvae only when they were held in enriched sea water, which was changed daily. In recent rearing trials, larvae of both brown and pink shrimp have been reared in sea water in 20-gal. (gallon) mass cultures with disodium salt of the metal chelator E.D.T.A. the only additive.

Development of an effective screening and filtering system (fig. 6) made it possible to discontinue the use of antibiotics during spawning and hatching. One end of a 20-gal. fiberglass tank has been fitted with a nylon screen of a mesh size too small to allow the eggs or larvae to pass through (0.18 mm. or 0.007 in.). Water is then pumped from the screened end of the tank and recirculated through a filter of crushed oyster shell without damage to the larvae. Water is recirculated through the filter from the time the ripe shrimp is placed in the tank until the eggs hatch and the first protozoeal stage begins to feed. Subsequently, the water is filtered only for 1 hr. a day. A metering pump furnishes a constant supply of the diatom, Skeletonema species, as food. A light beneath the tank attracts the larvae on the bottom; however, an air bubbler in the tank disperses the larvae throughout the tank.

Using the equipment and techniques described above, we have successfully reared brown and pink shrimp. During these two experiments, temperatures ranged between 26° C. (78.8° F.) and 27° C. (80.6° F.), and salinity varied from 24.1 p.p.t. to 20.5 p.p.t. Under these conditions the first postlarva was observed on the 13th day after hatching, and almost all larvae had metamorphosed to postlarvae by the 15th day.

In an effort to determine optimum conditions for population growth and maintenance of organisms to be tested as food for larval shrimp, four diatoms, two flagellates, and three dinoflagellates were each cultivated in nine different media. Although cell multiplication varied with the species and media tested, each organism produced the greatest number of cells in Miquel's sea water with soil extract. The population did not increase in sea-water controls. A similar experiment tested the effects of five fertilizers on population growth of the diatom, Skeletonema species. In promoting rapid growth, fertilizer composition appeared less important than its concentration. Dilutions in the range 1/10,000-1/100,000 induced greater increases in cell number than did stronger or weaker concentrations.

Two attempts to maintain 50-gal. cultures of Skeletonema with commercial fertilizers as a nutrient source in water from the laboratory's sea-water system proved unsuccessful; later, however, following the work of Johnston (1964),[8] we found that by adding E.D.T.A. in a concentration of 1 g. (gram) per 100 l. (liters) (about 15 g. per 25 gal.) of sea water, we could easily maintain mass cultures. The culture tanks are indoors, well aerated, and constantly illuminated with about 1,000 ft.-c. (foot-candles) of fluorescent light. Once the diatoms reach a peak density, we have maintained vigorous cultures by drawing off and replacing two-thirds of the water in the tank daily.

Work continued on how various environmental conditions and foods affect larval development. We completed one temperature experiment with brown shrimp larvae. Larvae

[8] Johnston, R., 1964. Sea water, the natural medium of phytoplankton. II. Trace metals and chelation and general discussion. J. Mar. Biol. Ass. U.K. 44 (1): 87-109.

reared at 18° C. (64.4° F.) and 21° C. (69.8° F.) died during the molt to first protozoeae; first postlarval stage was reached in 15 days at 24° C. (75.2° F.), in 12 days at 27° C. (80.6° F.), and in 11 days at 30° C. (86.0° F.). Six different organisms were tested as food for Trachypeneus similis larvae, with Skeletonema species as a control. Gymnodinium splendens gave the best survival; the Dunaliella species and Thalassiosira species, and a Euglenoid all gave better survival than Skeletonema; and two unidentified dinoflagellates gave poorer survival.

Harry L. Cook, Project Leader

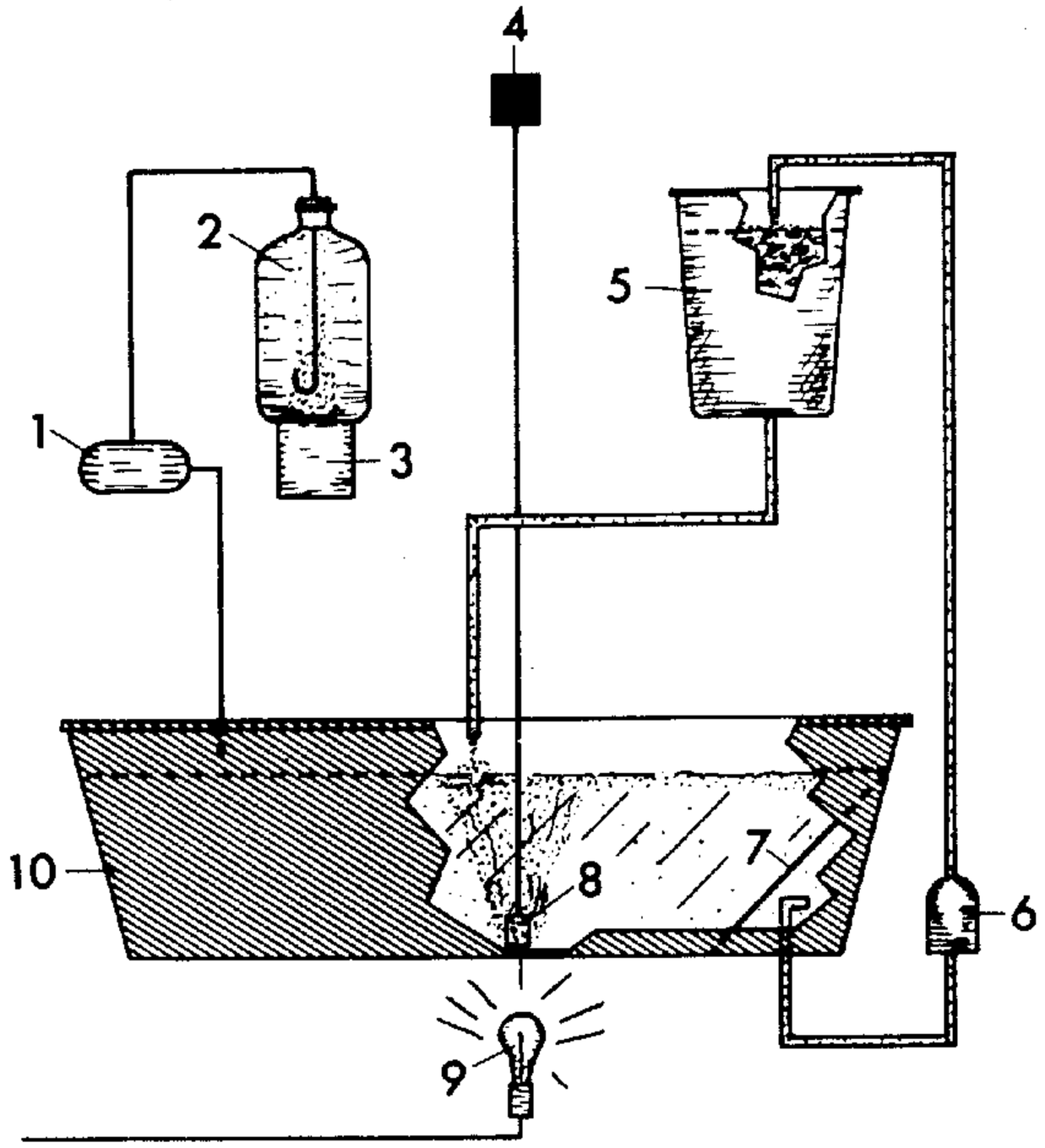

Figure 6.--Filtering system for mass culturing of penaeid larvae.

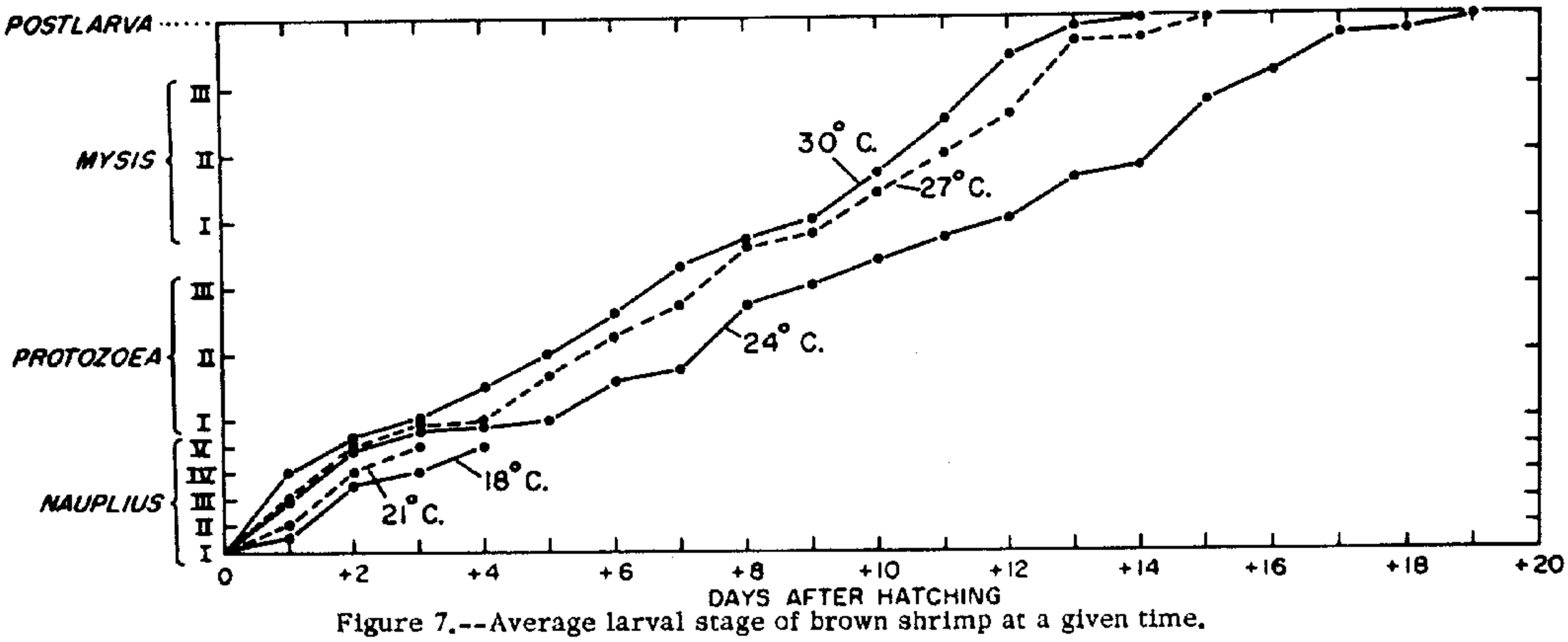

Figure 7.--Average larval stage of brown shrimp at a given time.